Chapter 8. Teams and Project- and Program-Based Organizations[1]

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Science and technology producing organizations differ from many other types of organizations in their dependence on the project as the primary unit of production and on programs as a principal organizing structure. Contrary to most organizations, which have attempted to reduce production to standardized processes, and where possible, automation, science and technology producing organizations strive for just the opposite -- projects and programs that employ new processes, new combinations of capabilities, and creative approaches to generate new knowledge. This is not to say that project-based organizations do not strive to develop and utilize repeatable project management processes and procedures or to implement integrating processes to assure efficiency, accountability, and quality, but rather that their core production work is not routine.

"Projects are the core business of research organizations" (Newfeld et al. 2001:49). Good project planning and execution is essential to excellent science (Jordan et al. 1999). High-performance teams can produce extraordinarily successful projects (Bennis and Biederman 1997), but ineffective project management often creates a significant barrier to successful innovation (Jonash and Sommerlatte 1999). However, as Mohrman et al. (1995:xv) point out, it is increasingly clear that "the effectiveness of teams cannot be understood apart from the organizational context in which they are embedded."

Project-based organizations face unique problems of coordination and strategic direction, as the teams composed to carry out the essential work of the organization are unusually independent and outwardly oriented. This is especially true of project-based organizations staffed by scientists and other professionals (Quinn et al. 1997:507). Although a few other industries share a dependence on project-based production (e.g., construction, civil engineering), most manufacturing, service, and government organizations do not. Consequently, most of the organizational literature is focused on non-project-based organizations, with the result that somewhat less is known about how best to design, manage, and lead project- and program-based organizations (Gelès et al. 2000). However, the research initiated by Penrose (1959) and Wernerfelt (1984) on a resource-based theory of organizations, as well as a growing interest in teams and team-based organizations during the past decade, has contributed useful insights into the factors that influence team and individual project success and the particular challenges of defining, developing, and empowering teams in knowledge organizations.

This review highlights some of the critical aspects of teams and of project- and program-based organizations that influence the success of individual projects and programs and the effectiveness of the organization as a whole.

[1] Related chapters include: Strategy; Competencies; Participative Management; Leadership; Organizational Communication, Innovation; Creativity

Definitions: Teams, Projects, and Programs

Teams

While most people have an intuitive understanding of what constitutes teams, projects, and programs, formal definitions assist in identifying some of the areas where project and program management create unique challenges for the organization. Mankin et al. (1996:23) define a team as a group of people who are task interdependent and share a goal or purpose. Katzenbach and Smith (1993:45) define a team as "a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable." According to Katzenbach (1998:70), the three critical litmus tests of a real team are:

- "Clear *collective work products* dependent on the joint application of multiperson skills
- *Shifting leadership roles* to be filled by different people at different stages of the effort
- *Mutual (as well as individual) accountability* for the group's overall results."

Sandstrom and Associates (1999:7) define a work team as consisting of "interdependent individuals who share responsibility for specific outcomes for their organization."

Types of Teams

Mohrman et al. (1995:20) distinguishes between the use of teams as *integrating mechanisms*, which increase the amount of information handled across the organization by enabling coordination and integration, and teams as *self-contained performing units*, which reduce the need for information processing across the organization. Trist (1981) and Pasmore (1998) also identify *self-contained teams* (also called self-managed or autonomous work teams, self directing teams, or self-regulating teams) as teams that can manage and execute a portion of the organization's work flow. Mohrman et al. (1995:20) conclude that knowledge-work settings often need both integrating teams and self-contained teams. They point out that cross-functional project teams are often called upon to integrate the work of the different functions while being as self-contained as possible, creating a conflict that can pose difficult design and management challenges.

Mankin et al. (1996:37) identify the defining characteristics of teams as "interdependence and shared goals and purposes," and offer the following relationship between team types and function:

- Work teams – to produce a particular product or service on a regular, ongoing basis
- Project teams – to develop a one-time output, such as a new product or service, new information system, or new plant
- Parallel team – to address special issues without fundamentally changing the structure of the organization
- Management team – to provide higher-level coordination and integration of different units and to provide direction and resources to these units
- Ad hoc network – to create informal collections of individuals and groups who share similar concerns, interests, and purposes from which other types of teams can later be formed.

Clark and Wheelwright (1997:420-422) identify four types of project teams:

- Functional teams, in which people are grouped principally by discipline under the direction of a specialized sub-function manager. Primary responsibility for the project passes sequentially from one function to the next.
- Lightweight teams, in which members reside physically in their functional areas but each functional organization designates a liaison person to represent it on a project coordinating committee to coordinate different function's activities.
- Heavyweight teams, in which the project manager has direct access to and responsibility for the work of all those involved in the project, managed by leaders who may outrank the functional managers. The core members of the team may be dedicated to the effort and physically co-located.
- Autonomous team structure, often called "tiger teams," in which individuals from different functional area are formally assigned, dedicated, and co-located to the project team, which gives the team strong focus but can make it difficult to fold the team members back into the organization when the project is completed.

Recently considerable attention has been focused on the use and effectiveness of *virtual teams* – teams that do not assemble in a common location, or belong to the same organization, but that communicate and collaborate across time, space, and organizational boundaries (Lipnack and Stamps 2000; Mohrman et al. 1998; Mittleman and Briggs 1999). Globalization and the availability of communication and collaborative technologies has led to increased use of virtual teams and networked organizations (Mohrman et al. 1998). The rapid expansion of computer networking and the increased availability and reduced cost of electronic collaboration tools such as e-mail, videoconferencing, electronic whiteboards, and group support systems has facilitated this trend (Mittleman and Briggs 1999). It is generally agreed that virtual teams pose special challenges for both managers and team members with all the difficulties of "real teams" exaggerated for virtual teams (Lipnack and Stamps 2000; Mohrman et al. 1998). However, continued improvement in technology applications that enable effective communication and collaboration by team members located in different locations and growing experience with those technologies is expected to continue to improve the effectiveness of virtual teams.

Organizations are also establishing greater numbers of inter-firm alliances that involve the formation of teams composed of representatives from a number of different organizations (Nooteboom 1999; Conner and Prahalad 1996). These types of *networked* teaming arrangements are discussed in Chapter 9, Organizational Alliances, Networks, and Partnerships.

Projects

The Project Management Institute Standards Committee defines a project as "a temporary endeavor undertaken to create a unique product or service" (PMI 1996:4). According to Kerzner (1998:6), "A project is an endeavor that has a definable objective, consumes resources, and operates under time, cost, and quality constraints. In addition, projects are generally regarded as activities that may be unique to the company. Any company could manage repetitive activities based on historical standards. The challenge is managing activities that have never been attempted in the past and may never be repeated in the future." Archibald (1992:31-32) defines a project as "… a complex, unique effort that cuts across organizational lines, has a definite start and finish point, and has specific schedule, cost, and technical objectives. A project, therefore, has important management differences when compared to a typical functional department handling repetitive work on essentially a never-ending basis…." Lewis (1998:10) identifies the key differences between managing in general and managing projects as: (a) the one-time nature of

projects; (b) the strong attention to schedule that is a feature of projects; and (c) the temporary and/or partial nature of team assignments. Cleland (1996:23) notes that projects "enable an enterprise to come up with an enhanced capability, a product and a process that best fits the organization's overall strategy. Projects provide a rigorous test of the enterprise's ability to integrate its resources and position itself for the future."

Shainis et al. (1994:203-207) describe projects as undertakings that:

- Are outside the organization's routine work
- Are unique, being something that may never be done again the same way, the project team disbands at the end, and the configuration or research plan will differ with each project
- Are temporary, having a specific beginning and end
- Create conflict by their nature, calling upon the functional, permanent organization to supply or forego resources on their behalf; the staff may command attention in a way that the functional staff doesn't, and because they are unique, each represents some change in the organization
- Evolve through phases, typically being concept, definition, realization, and operation
- Focus on a product or process that was developed for, or at the request of, a client thus making the client, rather than the organization, who a project team is working for. This client orientation is sometimes confounded by the fact that a project may serve layers of clients, rather than a single one.

The organizational implications of these characteristics of projects are numerous. First, projects stand in contrast to organizational processes, which are standardized, repeatable activities that underlie the productive process in most manufacturing and services organizations. The uniqueness of projects marks them as fundamentally different from normal operations. However, most of what we know about organizational design and management systems pertains to processes and the jobs and structures established to support them. One aspect of this uniqueness is the uniqueness of the product. In some significant way, the organization has never created just this type of product before. This implies both uncertainty and risk in the conduct of the project.

It is also useful to differentiate between projects conducted for internal sponsors and those conducted for external sponsors. One important characteristic of the national laboratory system is, for example, that most of the research and technical work conducted by the laboratories is dependent upon funding from external sources (typically public science funding organizations), and is consequently under the more or less direct control of external customers (particularly their federal agency sponsors). Although both in-house and externally sponsored projects require decisions about commitment of the organization's resources in ways that deliver returns and further the organization's strategy, externally sponsored projects introduce additional challenges of alignment, commitment, and control. Projects conducted for an internal sponsor are required only to meet performance standards and goals specific to the host organization. They therefore can be designed to reinforce understanding of and commitment to the organization's strategies and enhancement of its core competencies. Projects conducted for external sponsors have the significant additional challenge of simultaneously meeting the objectives of the external sponsor *and* the host organization.

The literature quite correctly stresses such management challenges as assuring corporate sponsorship and support, aligning the project with the organization's strategy, and coordinating challenges across the various organizational functions that have a stake in the project (Matheson

and Matheson 1998; Kerzner 1998:35-36), but it speaks less about the challenges of acquiring and managing a portfolio of externally-sponsored projects that matches the organization's strategic goals and of maintaining adequate control over their quality and execution. These challenges are compounded by the priority scientists and other professionals place on autonomy and individual entrepreneurship, and to the process by which scientists negotiate with sponsors concerning the specific research projects to be undertaken (Lambright and Teich 1981; Quinn et al. 1997).

Programs

Most definitions of program management simply refer to programs as a set of related projects, for example Archibald (1992:24), who defines a program as "A long term undertaking which is usually made up of more than one project." This definition does not adequately address two key functions of programs in project-based organizations. The first concerns the role of programs in strategy: The dependence of project-based organizations on projects to advance the organization's goals. While many writers point to the need for projects to be linked to strategy (Matheson and Matheson 1998), they generally fail to acknowledge that this linkage frequently requires a project to be placed in the context of an integrated development program. Programs are more than the categorization of similar projects, or even the assignment of similar projects to a common management team. Instead, programs are integrally related projects, which together move toward the realization of a particular organizational goal. The better designed and managed the program, the more efficiently the goal is realized. Neufeld et al. (2001:46) identify the ability to develop a portfolio of program that represent "the right research at the right time and at the right investment" composed of research projects that effectively leverage external resources" as essential attributes of high-performance research organizations.

The second concerns the role of programs in human resource management in project-based organizations. Both from an organizational perspective (optimizing investment in human resources) and from an individual staff member's perspective (achieving career coherence and stability), well-constructed programs provide advantages, indeed essential conditions. Programs provide the professional with the opportunity to develop and apply skills across a number of projects and across a significant span of time. Programs allow organizations to develop investment plans in human and other resources that benefit multiple projects and multiple internal and external customers by supporting the development of core competencies.

Trends in Organizational Design

On the surface, project management appears to be considered a skill rather than an organizational phenomenon. There are literally hundreds of books, manuals and training classes designed to instruct the project manager in the administration of projects. These resources acquaint the manager with tools for designing work breakdown structures, assembling project teams, and tracking project performance using sophisticated analytic and forecasting methods. Taken at this level, project management is akin to accounting as an organizational phenomenon – straightforward in principle, but very complicated in actual practice. However, in recent years, project-based organizations have emerged as a significant organizational form. While some organizations, such as research laboratories, have always been organized around projects, and NASA-invented matrix organizations designed specifically to implement large, technically challenging, and highly complex projects have been around since the 1970s, most organizations in the modern era have been organized around either differentiated elements of a linked productive process or differentiated elements of the market. Recently, however, a number of

factors have led organizations from an increasingly wide spectrum of industries to organize around team-based projects (Stewart 1997:202-204).

An important trend in project-based organizations is the evolution toward greater project complexity. For example, Evaristo and Fenema (1999) maintain that the emergence of global markets and the revolution in communications technologies are leading organizations to undertake projects with widely distributed project teams as well as projects that are cooperative undertakings of multiple organizations in a particular supply chain. The resulting complications in communication, coordination, and project management skills are predictable. A similar trend may be emerging within the scientific community, where the increasing complexity of the research undertaken along with the dependence of that research on very expensive facilities and equipment are creating a need for both distributed project teams and inter-organizational cooperation in project definition and management. Archibald (1992:14-15) argues that the "inexorable evolution of technology" pushes organizations toward a greater focus on project management as more and more of the organization's resources are tied up in increasingly complex projects. Organizations tend to become more internally complex in order to respond to the external complexity (Lawrence and Lorsch 1967), and one way to deal with the demands of increased internal and external complexity is to organize around teams (Galbraith 1994).

Mohrman et al. (1995:6-11) identify several trends that are leading organizations to place greater emphasis on teams and projects as keys to organizational success. These trends include the need to:

- Reduce the cycle time and time to market of new products while improving quality – organizations are moving to new product development teams that cross-cut the established functional boundaries in organizations and enable parallel and concurrent rather than sequential activities
- Respond more comprehensively and precisely to individual customer demands – the increased customer focus and real-time interactions with customers is leading organizations to assemble teams that address customer needs through projects
- Engage in process improvement – organizations are frequently implementing internal improvement projects that overlay the organization and draw team members from the diverse functional groups that are involved in a particular process.
- Coordinate and integrate complex, geographically dispersed activities – organizations are establishing management teams responsible for integrating the contributions of the various participants and attending to the relevant components of the external environment without proliferating the formal management structure of the organization.

Katzenback (1998:70) emphasizes the growing importance of leadership capacity – the ability to extract leadership wisdom, insight, and behaviors from many more individuals – and the recognition that teams provide an effective way to expand leadership capacity. He argues that when team configurations work, they enable the same number of individuals to provide greater and more effective leadership– even at the top of large organizations.

Graham and Englund (1997:10) emphasize the impact of the increased focus on customer service, observing that "…to provide today's customers with total solutions, project-based rather than product-based organizations are best. The new organization uses multi-disciplinary teams that move across the organization on the customer's behalf to provide a total solution. This continuing trend means that project management is the future of organizational management."

Mohrman et al. (1995:5-6) note that "[T]he use of teams and teaming mechanisms to integrate organizations laterally has increased dramatically in recent years. This is because many organizations, especially those that are highly complex, have found that traditional hierarchical and functional approaches are inadequate to address their coordination needs in a timely and cost-effective manner….More recently, there has been an increase in the use of teams in settings that house knowledge work…." Nonroutine knowledge necessarily involves learning, which must be focused on the *content* of the work, the *process* of the work, and/or the *organization* that is needed to carry out the work (Mohrman et al. 1995:18). "The major organizational challenge in nonroutine knowledge work settings is to integrate the work of the various contributors. In these settings, teams are essentially established as forums in which the various interdependent specialties can integrate their work to accomplish collective goals. Teams are structural mechanisms through which task interdependencies can be worked out, issues involving trade-offs between various perspectives can be resolved, and solutions and approaches that build upon the diversity of relevant expertise and perspectives can be determined" (Mohrman et al. 1995:19).

Design Implications of Scientific, Project-Based Organizations

According to Jay R. Galbraith (1973, 1994:14), an organization's design is comprised of five inter-related elements:

- Structure
- Processes
- Rewards
- People
- Task or work systems.

Each organization seeks to tailor these elements to support its strategy within its particular environment. An "appropriate organizational design enables an organization to execute better, learn faster, and change more easily" (Mohrman et al. 1995:7). A good fit between strategy and organizational design creates a competitive advantage for the organization (Galbraith et al. 1993).

Burns and Stalker's classic study, *The Management of Innovation* (1961), identified two types of organizational forms – organic and mechanistic – and found that organizations with an organic form were more effective in dealing with rapidly changing markets and technologies, while those with a mechanistic form were more effective in stable markets. This finding has been consistently confirmed for both entire organizations and organizational components. Hall (1962) for example, found that the research and development departments of organizations tended toward organic forms while their production departments approximated the mechanistic form. Although the classic bureaucratic form has long been the design of choice in stable environments of low complexity, it has been found inadequate in rapidly changing environments of high complexity and uncertainty such as those currently facing science and technology organizations. In these circumstances, designs that create mechanisms to attain an integrated pattern of behavior across all interdependent groups, for example by providing greater lateral forms of communication and joint decision-making processes, are considered necessary to support the innovation and coordination needed to remain competitive (Galbraith 1973:14, 46). The need to provide better ways to integrate organizations laterally has been a significant motivation for greater use of teams and teaming mechanisms (Lawrence and Lorsch 1969).

Mohrman et al., in their influential book *Designing Team-Based Organizations: New Forms for Knowledge Work* (1995:xvii) emphasize that teams "violate the logic of bureaucratic,

hierarchical, segmented organizations" and that team-based organizations need to be redesigned with a "new logic," one that takes into account the need for lateral integration and coordination, new assumptions, and different values. They emphasize, and Quinn et al. (1997) concur, that there are many challenges of organizing for non-routine knowledge work, the hallmark of organizations engaged in scientific research:

- Members of knowledge-based teams usually have "highly developed and often specialized knowledge sets….most have gone through extensive education and training, becoming steeped in the 'thought-world' of their discipline" (Mohrman et al. 1995:16 based on Doherty 1992).
- Scientists and other professionals have "learned to attend to certain aspects of their environment, to value particular approaches to work and ways of thinking, to filter information to conform to their paradigms of understanding and action, and to value particular outcomes. Communication and integration across the thought-worlds of different specialties is not easy….Integrated, coordinated action is also difficult" (Mohrman et al. 1995:16).
- Nonroutine knowledge work typically "includes much variety and many exceptions to any programs that have been developed…[and] may also be characterized by an incomplete cause-effect understanding, which introduces uncertainty into the work," particularly for organizations seeking to push the frontiers of knowledge. Under these circumstances, decision making requires greater judgment and interpretation (Mohrman et al. 1995:16).
- The novelty and specialized nature of the work makes performance evaluation more subjective and complex. Quinn et al. (1997:510) conclude that the characteristics of professional work requires the use of three separate evaluation methods: (1) by peers for professionalism; (2) by customers for relevance; and (3) enterprise norms for net value.

Katzenbach and Smith (1993:5) disagree that teams necessarily threaten hierarchical structures and basic organizational processes. They advocate the use of teams, in the right places, to integrate across structural boundaries and enhance formal structures and processes of hierarchical organizations.

Organizations dependent upon the work of scientists and other professionals need to be designed to address the typical characteristics of their staff, who tend to have been trained as elites, identify more with their profession/discipline and peers than their organization, and prefer to surround themselves with people having similar backgrounds and values (Lambright and Teich 1981; Quinn et al. 1997). These characteristics can lead to discipline-based cocoons that are resistant to change, detached from customers, contentiousness, and, because the professional's power base is their knowledge, reluctant to share information unless there are powerful inducements (Quinn et al. 1997). By organizing around intellectual flows rather than command and control concepts and designing performance measurement and incentive systems that reward the development of intellectual assets and customer value (in addition to the production of profits and efficient use of physical assets), organizations can focus their resources where they can create uniquely high value and leverage the organization's intellect most effectively. They suggest that the design of professional and knowledge-based organizations should be based on assessment of the following four key factors ((Quinn et al. 1997:514):

- Locus of intellect, where deep knowledge of the firms' particular core competencies primarily lies
- Locus of customization, where intellect is converted to novel solutions

- Direction of intellectual flow and the primary directions in which value-added knowledge flows
- Method of leveraging the organization's intellect.

Project-based organizations, though using teams in their principal production activity, may not be entirely team-based organizations: functions such as contracting, marketing, human resources, etc., may not all be organized into teams. Consequently, although these organizations undoubtedly do use a variety of teams, they are more likely to be a hybrid than a totally team-based organization of the type described by Mohrman et al. (1995) and Katzenbach (1998).

Managing Teams, Projects, and Project- and Program-Based Organizations

Building Effective Teams

Reflecting the importance of teams to organizational performance, a substantial literature has developed on teambuilding and team effectiveness (Hackman 1990; Katzenbach and Smith 1993). Weisbord (1987:296-298) credits McGregor's *The Human Side of Enterprise* (1960) and *The Professional Manager* (1967) with recognizing the importance of teamwork and the challenges US individualism poses for effective team development. A common theme in the literature on team effectiveness is the importance of leadership and management of the team's efforts. Weisbord identifies four conditions needed for team success:

- Interdependence (working on important problems in which each participant has a stake)
- Leadership
- Joint decision (all members agree to participate)
- Equal influence (each person has the opportunity to influence the agenda).

Eric Sundstrom and Associates (1999) emphasize the importance of effective support systems for team building and effectiveness. They identify three fundamental challenges that face organizations attempting to establish effective teams: (a) defining the teams clearly enough to give them identity as work units; (b) preparing the support systems essential to effective teams; and (c) tailoring the support systems to the type of team. Team structure and composition, leadership, training, performance measurement and rewards, communication, and informational and physical infrastructure are identified as critical to the building of effective teams.

Mankin et al. (1996:ix) assert that "teams and information technology are two of the most important developments in organizations today" and that teams and information technology need to be developed and introduced synergistically. Their team design process includes identifying the type of team needed and its goals; determining and establishing team structure, composition, leadership, and external connections; and developing team capabilities by providing access to information resources and training.

The Discipline of Project Management

Project management is not a new phenomenon in organizations. Engineering organizations, science organizations, and consulting organizations have depended on the practice of project management throughout their histories. This does not mean, however, that project management has consistently been done well. Only in the last thirty years or so has there been a concerted effort to turn the practice of project management into a recognizable discipline – a discipline with

standards, accreditation, widely shared best practices, and an institutional infrastructure to advance the discipline (Kerzner 1998; 2000).

Archibald (1992:14) observes that the acceptance and use of formal project management concepts began in the 1950s to organize the work on complex new systems in the military/aerospace industry and design and construction of capital facilities. During the 1980s, formal project management practices spread to a much wider range of industries. Armstrong (1992:14 adds: "As managers in these various industries recognize that they have complex projects and multi-project programs on their hands, they have adopted some or all of the project management practices …." Graham and Englund (1997) predict that the importance of project management will continue to grow as the importance of projects within organizations continues to grow.

The current state of the discipline of project management can perhaps be best captured in the curriculum of the Project Management Institute (1996), which covers the following topics:

- Project Integration Management – project plan development, project plan execution, and project change control
- Project Scope Management – project initiation, scope planning, scope definition, scope verification, and scope change control
- Project Time Management – activity definition, activity sequencing, activity duration estimating, schedule development, schedule control
- Project Cost Management – resource planning, cost estimating, cost budgeting, and cost control
- Project Quality Management – quality planning, quality assurance, and quality control
- Project Human Resources Management – organizational planning, staff acquisition, team development
- Project Communications Management – communications planning, information distribution, performance reporting, and administrative closure
- Project Risk Management – risk definition, risk quantification, risk response development, and risk response control
- Project Procurement Management – procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract close-out.

One of the obvious implications of this description of the discipline of project management is the breadth of scope of capabilities that it requires. The scope is much broader than that of designing and conducting good research that applies accepted scientific standards and practice. Instead, the project manager must interface with various business systems (e.g., procurement, quality control, security), must represent the organization's interests in the area of risk management, must manage the project toward organizational as well as scientific goals, and must lead teams. Very little in the professional training that scientists receive prepares them to conduct these myriad tasks with excellence. Therefore, part of the discipline of project management has to be found in the organizational cultures and systems that prepare project managers and their teams to undertake these responsibilities. Kerzner (1998) provides a good discussion of the organizational factors necessary to support a mature project management discipline.

Throughout the literature on team effectiveness and project management emphasis is placed on the establishment of appropriate performance goals, metrics, feedback systems, and rewards. In the scientific world, peer reviews are commonly used to fine-tune direction and pace and to provide an additional avenue for interactions that can provoke innovation and creativity. Increasingly, efforts are underway to develop performance metrics that capture the value of basic

research and document progress toward the development, dissemination, and application of new knowledge.

Developing and Supporting Effective Project and Program Managers

Early literature on the role of project and program managers emphasized the administrative aspects of project and program management. These included monitoring the project's process relative to scope, schedule and budget, as well as compliance with the quality standards of the organization. However, it is increasingly recognized that the role of project and program managers requires leadership as well as administrative skills (Mankin et al. 1996; Mohrman et al. 1995). Among these skills are coaching skills; vision-building; communication; conflict resolution (Mohrman, et al. 1995); boundary management, coordination, and decision-making in the team context ((Mankin, et al. 1996); and entrepreneurship and negotiating skills (Stewart 1997). Jain and Triandis (1997:28-29) identify effective project leadership as calling "… for individuals who are able to plan and organize various project activities and can ensure that administrative and coordination requirements are met. They should have the ability to provide leadership and motivation and to be sensitive to the needs of others. They must be able to understand the organizational structure, both formal and informal, so that they can get things done and balance the project goals with organizational needs. They should be interested in a broad range of disciplines and be able to handle multidisciplinary issues." These skills are especially important in program management where the key challenges pertain to coordinating activities across projects, organizational units, and even multiple organizations. It is decreasingly likely that a particular project manager will have unambiguous authority over all the resources necessary to conduct the project. Thus, the ability to motivate, coordinate, and influence within the organization are as important as the abilities to plan and administer.

One of the challenges facing organizations is the development of the project and program manager career track. According to many observers, project management is replacing line management as the core management competency of organizations in the post-industrial society (Stewart 1997:202-204). However, organizations are not yet prepared to deal effectively with this fact. For example, while project and program management may be increasingly central to organizational success, line management still retains authority, power, prestige, and perquisites in most organizations. Project and program managers are more valuable than they are valued.

For the staff member who is in the project management track, these factors lead to several important realities:

- First, careers look less like steps on a ladder than ever expanding responsibility for organizational impact. As project managers progress, they are likely to be given the riskier and more difficult projects with the greater potential return to the organization
- Second, the success of the project manager within the organization lies with his/her expertise and skill rather than his/her authority and position (Stewart 1997:209). This expertise includes knowledge of what is of strategic value to the organization, the ability to negotiate, the ability to make the business case, and the ability to lead teams.

Using teams as an organizing structure is not an easy strategy to implement. An operation organized around teams, supported by a management structure that emphasizes team support and leadership, uses teams wherever the collective work products seemed to justify it. (Katzenbach 1998:22).

Establishing teams in knowledge-based organizations presents a number of challenges. The highly interdependent and dynamic technology and state of knowledge in these settings makes it more difficult to define, develop, and empower teams. In addition, organizations generally apply models that were developed in production settings for routine work, and these team models do not always fit the new work settings" (Mohrman et al. 1995:6)

Team-based organizations create heavy coordination demands on key players, who are called upon to participate in numerous meetings and solve problems that may be framed in unfamiliar terms by persons from a different discipline and/or organization. Managers at all levels find themselves managing and coordinating an increasing array of diverse and demanding teams. Project management becomes a critical competency and resource. In a recent survey of leading technology firms, for example, problems with effective project management were identified by 41 percent as a major inhibitor to successful innovation (Jonash and Sommerlatte 1999). Thus, it is clearly the case that project and program management cannot be taken for granted. One of the key factors influencing project management success is the structure of the organization within which the project takes place. Archibald (1992:45) points out that organizations conducting projects face a dilemma of achieving a proper balance between the long-term objectives of functional departments in building technical expertise and the short-term objectives of the project in delivering results to the client.

Kerzner (1998:7) writes, "Effective project management requires extensive planning and coordination. As a result, work flow and project coordination must be managed horizontally, not vertically as in traditional management. In vertical management, workers are organized along top-down chains of command. As a result, they have little opportunity to work with other functional areas. In horizontal management, work is organized across the various functional groups that work with each other. This results in improved coordination and communication among employees and managers…. When project managers are required to organize their work horizontally as well as vertically, they learn to understand the operations of other functional units and how functional units interface. This knowledge results in the development of future general managers who understand more of the total operations of their company…."

The realities and benefits of working horizontally in project-based organizations do not necessarily mean that most organizations support effective horizontal integration. As several authors have pointed out, projects frequently have to overcome the fact that the vertical aspects of organizations can limit the ability of the project manager to pull together the horizontally integrated teams that are important for project success (Archibald 1992; Kerzner 1998; Mohrman et al. 1995). For organizations to be truly effective in executing projects, the organizational structure probably needs to migrate from one based on vertical relationships to one based on teams (Mohrman et al. 1995). This represents the next step beyond the traditional functional/project matrix structure that has been common in many of the organizations that perform much of their work through projects (Archibald 1992).

Because the project is temporary, it also tends to bring together staff from different parts of the organization who have different backgrounds. This suggests that another key organizational dynamic in a project is the integration of the project team in the context of a potentially ambivalent organization. Pava (1983) emphasizes that in highly specialized, interdependent, and dynamic knowledge-work settings [such as public science organizations], the analysis needs to focus on identifying the key deliberations needed to resolve trade-offs, establish direction, and

enable coordinated activity, and the design needs to provide for this integrative functions. Again, successful integration will require both skilled project management and the commitment of the organization to the specific project and to the concept of working horizontally (Kerzner 2000). This "mixing and matching" of staff that occurs in the course of projects provides one of the key ingredients of creativity and innovation – connections and linkages among people with different knowledge and perspectives.

The Application of Teams and Project-Based Organizational Design and Management to Public Science Management

Federal sponsors of science have long been attentive to the practice of project management in their laboratories and in other organizations contracted to complete scientific studies. Indeed, within these agencies, program managers play a vital role and provide some of the most direct linkages with the science implementing organizations. There are, however, several implications of this review for project and program management:

- Laboratories differ in their approaches to project management training and required standards and procedures. The agency sponsors should consider whether those differences reflect reasonable adaptations to local organizational culture or the nature of the work undertaken, or whether more uniform guidance would lead to better overall performance across all supporting research entities.
- Effective project management requires effective team leadership and other non-administrative skills (communication). To assure that all projects have the maximum likelihood of success, sponsoring agencies should be attentive to the systems that their laboratories put in place to train and select for project managers with these skills, and to reinforce the practice of these skills on projects. These systems should include mentoring and on-the-job training.
- Increasingly, projects require collaboration among organizations at both the sponsorship and implementation levels (for example among several DOE laboratories). Competition, long-distance communication, and incongruent cultures and systems can jeopardize the outcome of these projects. Both sponsoring agencies and the implementing organizations should take steps to identify the particular requirements and vulnerabilities of such projects and ensure that they are being addressed, perhaps through the development of guidance and tools to help the several organizations work more effectively together.
- In order to derive maximum benefit from the human and other resources resident in its laboratories, sponsoring agencies should consider how the laboratories define and configure programs that simultaneously align multiple projects to systematically address priority scientific issues, while providing research staff with coherent and rewarding careers. This will require attention to the internal program management structure within the sponsoring agencies and assessment of the changes that might be required internally to accomplish this goal.

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